HYDROCEPHALUS :-

It is an active enlargement/ bulging / expansion of ventricular system of brain arising when an imbalance exists b/w CSF production & absorption.

CSF formation & Absorption → Super

↓

500ml/day by choroid Plexuses of

↙ ↘

lateral Ventricles (greater amount) → Central canal of Spinal Cord

3rd & 4th ventricle (lesser amount) → 3 Apertures in Roof (1 median 2 lateral)

↓

Open in

↙ ↓

Subarachnoid space around Spinal cord & Cauda equina

Subarachnoid Space in cranial cavity

↓

Tentorial notch

↓

Inferior surface of cerebrum

↓

Superolateral surface of cerebrum

↓

Arachnoid Granulation

←

Absorption

↑

Superior Sagittal Sinus.

Actio (causes)

Total CSF volume in Adult is 150 ml distributed b/w → Cerebral ventricles
Cerebral subarachnoid space
Spinal thecal sac.

Classification & Aetiology :-

① OBSTRUCTIVE HYDROCEPHALUS :-

It can be caused by any lesion blocking the CSF pathways from the lateral ventricles to the 4th ventricle.

② COMMUNICATING HYDROCEPHALUS :-

There is accumulation of CSF, usually due to impaired CSF absorption.
↳ (May be because the CSF elements have altered such as in case of meningitis/subarachnoid hemorrhage (SAH).

Causes -

	OBSTRUCTIVE	COMMUNICATING
Acquired -	• Lesions within the ventricle • Lesions in the ventricular wall • Lesions distant from the ventricle but with a mass effect	• Post haemorrhagic • CSF infection • Raised CSF protein Excessive CSF production - (rare) - choroid plexus papilloma/carcinoma
Congenital -	- Aqueduct stenosis/forking - Dandy-walker syndrome - Chiari malformation	

fontanelle - space b/w the bones of skull (b/w frontal & parietal bone)

Tense - bulging

gaze - stare (टकटकी)

Clinical Features :- INFANTS & YOUNG CHILDREN -

1. Tense Anterior fontanelle
2. Cracket pot' sound on skull percussion
3. ↑ed Skull Circumference
4. Lid Retraction → sclera is visible
5. Impaired Upward gaze } "Setting Sun" Appearence.
6. Thin Scalp with dilated veins.

Acute Onset -
Irritability, impaired conscious level & vomiting

Gradual Onset -
Mental Retardation, Failure to thrive. (grow / develop well)

JUVENILE / ADULT TYPE HYDROCEPHALUS -

Acute Onset
→ Impaired Upward gaze.
→ ↑ICP (Intra cranial Pressure)
↓
headache, Vomiting, papilloedema, deterioration of conscious level

Gradual Onset
→ Dementia
→ Gait ataxia
→ Incontinence.

Pathological Effects :-

CSF flow obstruction / Impaired Absorption
↓
Ventricular dilation
↓
CSF spread through ependymal lining into periventricular white matter
↙ ↓
Raise ICP | White matter damage & gliotic scarring.

Some CSF absorption occur from periventricular b/d vessels.

In Infants

Head Expansion ↘ ↙ Ventricular dilatation

↓ ↓

Suture fusion

↓

Only leaving a thin rim of Cerebral cortex.

↓ ↓

Untreated — In many cases.

↓ ↓

Death — Hydrocephalus Arrests (stop).

↙ ↓ ↘

Ventricle Remain dilated — ICP return to Normal — CSF absorption appears (to balance production).

↘ ↙ ↓

Normal Developmental patterns Resume — Pre-existing mental/physical damage may leave a Permanent handicap

⇒ In these patient → Minor injury/infection

↓

CSF dynamics Unstable again.

Investigation:-

Skull X-ray -

Note- Skull size & suture width, evidence of chronic Raised ICP result in → "Copper Beating of skull"

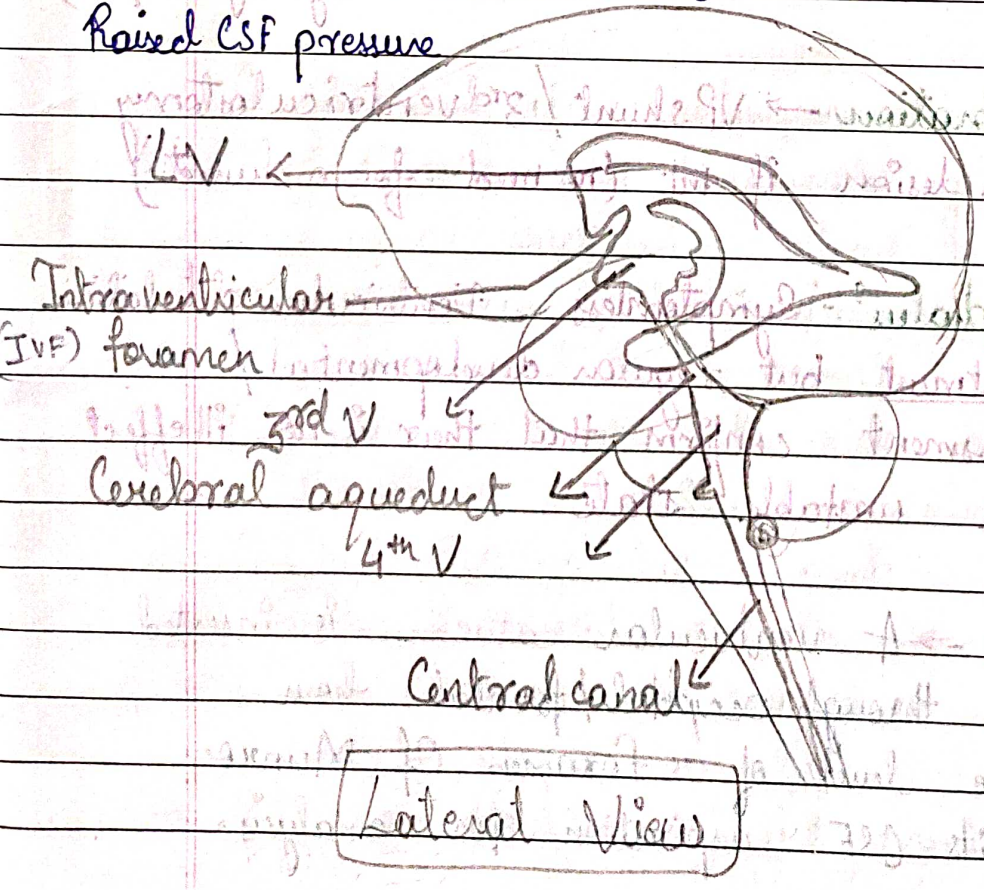
Ultrasonography - through → Ant. fontanelle →

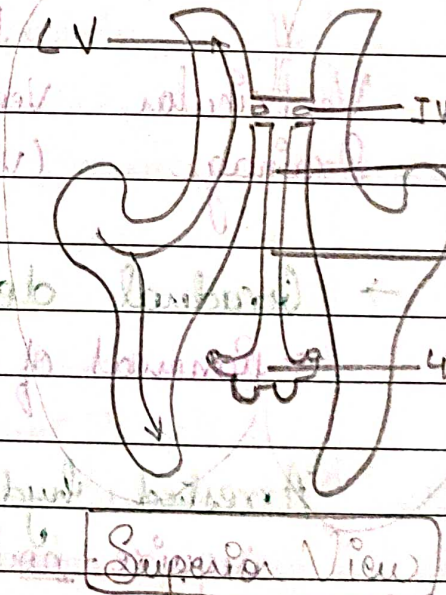
Demonstrate ventricular enlargement in infant

Periventricular - covering of Ventricle
Posterior fossa structures → Cerebellum, Pons, Medulla
basal cistern → space b/w arachnoid & pia matter

CT scan :- (Computerised Tomography)
Shows the pattern of Ventricular Enlargement
helps determined the cause

- lateral + 3rd Ventricular dilatation → Normal 4th ventricle → Suggests Aqueduct (narrowing) Stenosis → Periventricular (shiny) lucency → Raised CSF pressure
- lateral + 3rd Ventricular dilatation → Deviated / -nt 4th Ventricle → Suggest a posterior fossa mass
- Generalised Dilatation → 4th ventricle outlet / basal cistern obstruction





haemorrhage - an escape of blood from a ruptured blood vessel

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MRI - (Magnetic Resonance imaging).

→ It provide better anatomical detail of lesions/obstruction.
→ Usefull in diagnosis of Aqueduct Stenosis.
→ A midline T2 - weighted MRI scan used to assess the suitability for a 3rd ventriculostomy.
→ Show similar ventricular expansion.

ICP monitoring - useful diagnostic tool for patient in whom Hydrocephalus / CSF shunt dysfunction is suspected.

Management -

→ Acute deterioration (worsening)
- ↓ Ventricular Drainage
- ↓ Ventriculo-Peritonial (VP) shunt
- → 3rd ventriculostomy (if tri-ventricular - obstructive Hydrocephalus)
- → Lumbar Puncture (if communicating Hydrocephalus)

→ Gradual deterioration → VP shunt / 3rd ventriculostomy
→ Removal of mass lesion if tht (no need for a shunt)

'Arrested hydrocephalus' - Symptomless Ventricular dilatation require - no treatment but regular developmental / psychometric Assessment confirm that their is no ill effect develop by this unstable state.

SHUNT TECHNIQUES → A ventricular catheter is inserted through occipital / frontal horn. The tip lie at the level of Foramen Of Munro.
→ A reservoir permits CSF aspiration for analysis.

A valve is incorporated in the system with either

High ← ↙ ↘ → fixed opening pressure.
Midium ← pressure / flow → Variable " "
low ↙ regulator → Programmable.

VA → Ventriculoatrial shunt - Distal catheter insert through Internal jugular vein to right atrium (T4/7 level on chest X-ray)

→ Ventriculoperitoneal shunt - Distal catheter inserted into the peritoneal cavity. In children, redundant coils permit growth without revision.

→ Lumboperitoneal Shunt - catheter inserted into the lumbar theca either directly at open operation / percutaneously through a Touhy needle. The distal end is sited in peritoneal cavity.

→ Third Ventriculostomy - By using a flexible / rigid endoscope introduced through a frontal burrhole, a fistula (passage) is created in the floor of 3rd ventricle.

→ 2/3 patient obtain permanent benefit, avoid the problem of shunt

Complication of shunting -

1. Infection - result in Meningitis, peritonitis etc.
V-A shunt / Bacterimia lead to shunt 'nephritis'
→ Staphylococcus epidermis / aureus are involve in infants.
→ Antibiotics ~~&~~ in in neonates, Antibiotic Impregnated shunt system → use the risk of infection.
→ If occurs → Shunt removal is imp.

2. SHUNT BLOCKAGE - effect → Ventricular catheter, shunt valve / distal catheter.
→ Causes of blockage → choroid plexus adhesion, b/d, clot, cellular debris / misplacement of distal catheter.
→ CT scan conform shunt malfunction.

3. Shunt system may Over drain lead to SUBDURAL HAEMORRHAGE / Slit ventricle syndrome.
→ Risk reduce by • Variable pressure / programmable value.

4. LOW PRESSURE STATE - following shunting, some patient develop Headache & vomiting on sitting / standing.
→ It is resolve by high fluid intake & gradual mobilisation.
→ If not resolve, Insertion of an Anti-Syphon device / Conversion to a high pressure value is require.

Prognosis - → Irreversible brain damage.
→ Result are good with most children attain normal IQ.
→ Repeated Complications

In infancy	In young children
Prevented	Significant (unhealthy state of mind) morbidity.